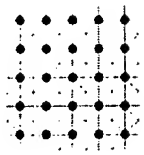
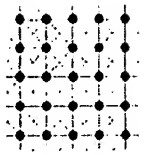
APPENDIX A



parimics

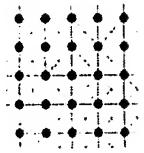
Parallel Image Computation System

Parallel versus Sequential Architecture



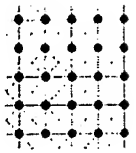
Parallel versus sequential

- MPP SIMDs like Parimics' IPE can access neighboring cells in a TDM fashion without conflict or contention.
- Sequential – even SMP – architectures need to go through a NorthBridge with an arbiter to access common (shared) memory.
- Memory is accessed using RAS and CAS as well as bank select. Only one entity can drive the address signals at any time, and that is the NorthBridge.



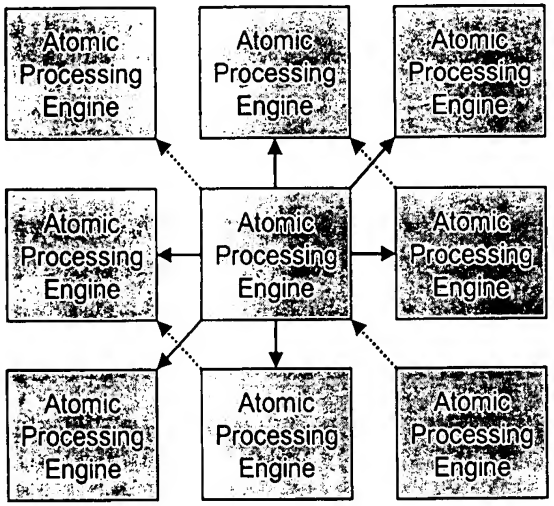
Slide Show explanation

- The following slide show explains accesses of both an MPP SIMD to neighbors and an SMP into DRAM.
- The NorthBridge contains an arbiter and the DRAM controller.
- Arrows point in the direction of signal flow, be it address or data.
- Dotted arrows indicate read requests or address signals, dashed arrows indicate data signals.

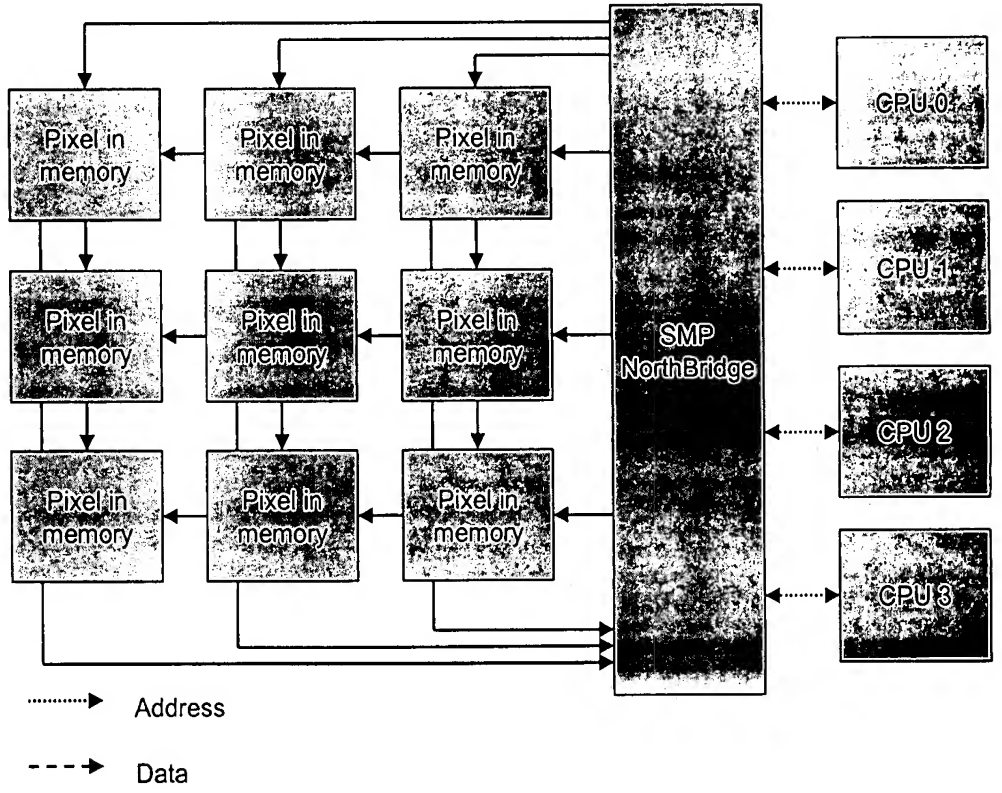


Cycle 0a

Parallel: Read Request 0

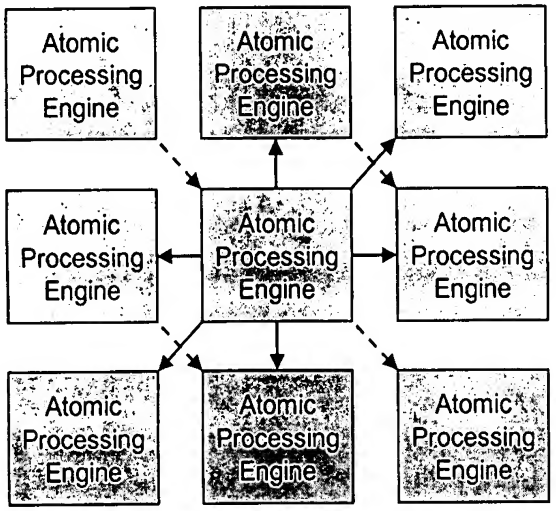


Sequential: Read Request CPUs to NorthBridge

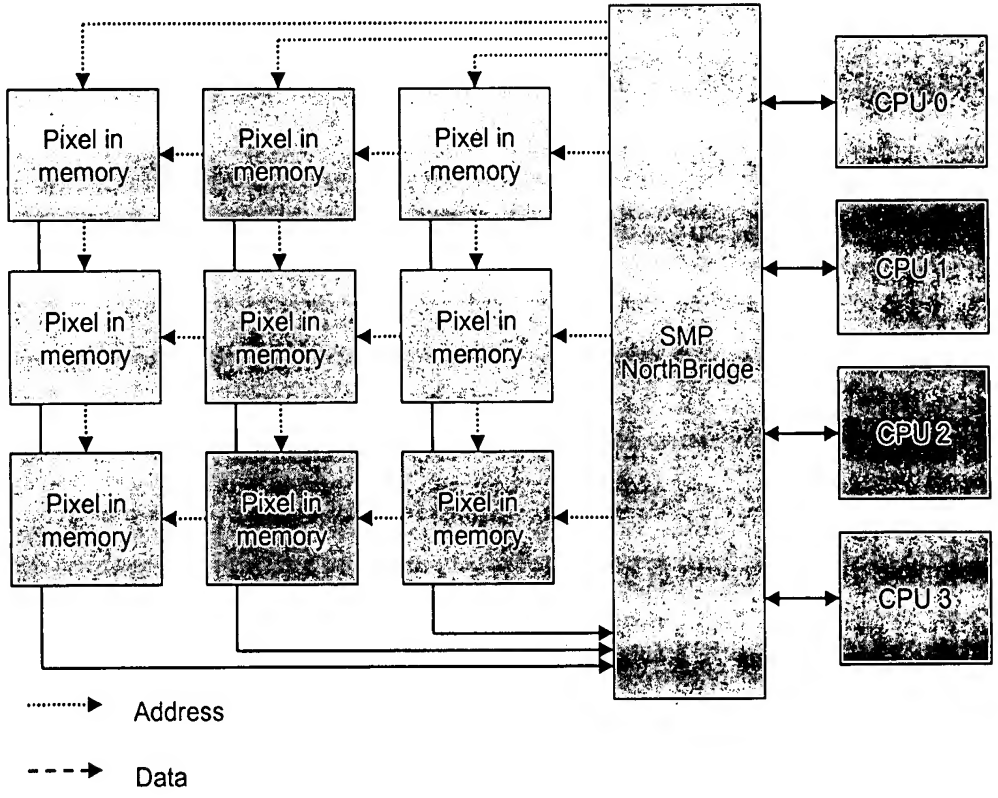


Cycle 0b

Parallel: Data 0

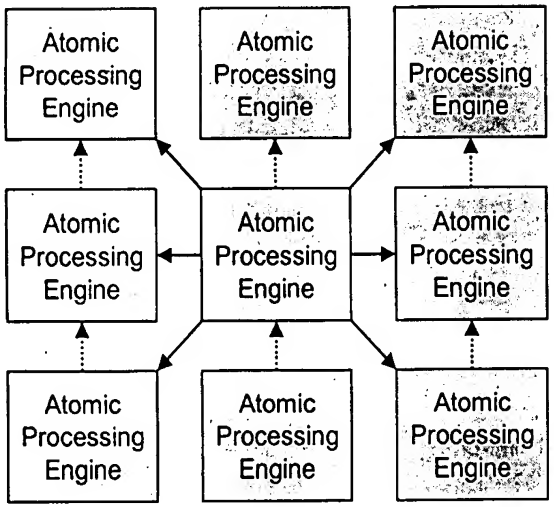


Sequential: RAS and CAS from NorthBridge to DRAM

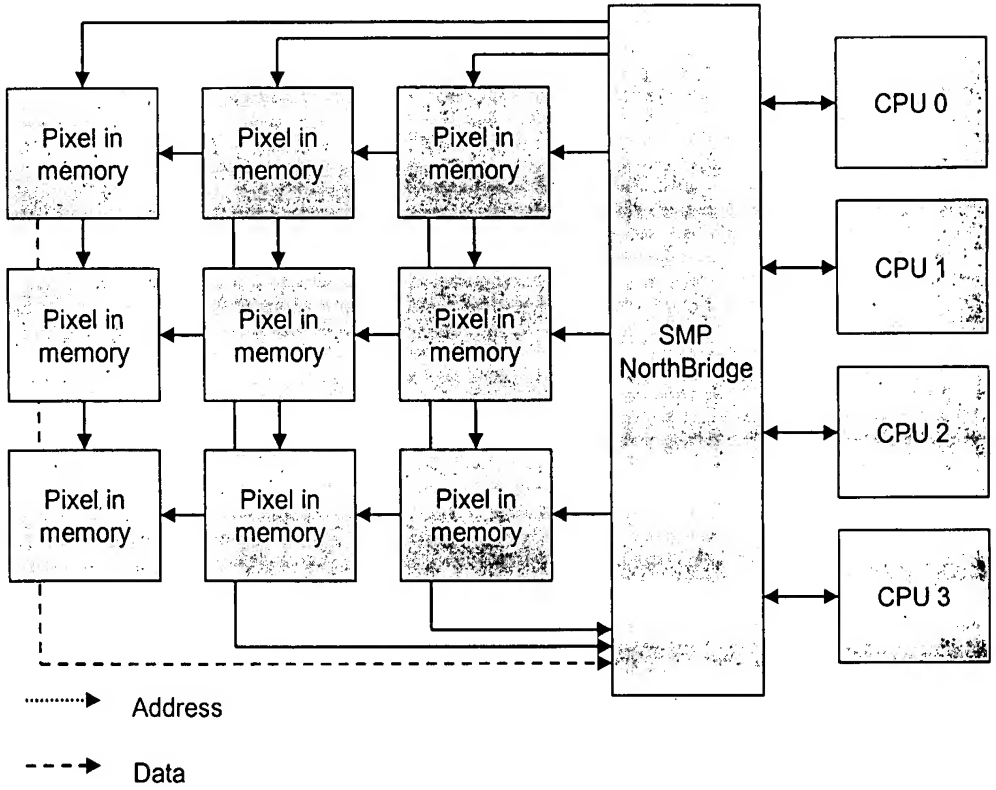


Cycle 1a

Parallel: Read Request 1

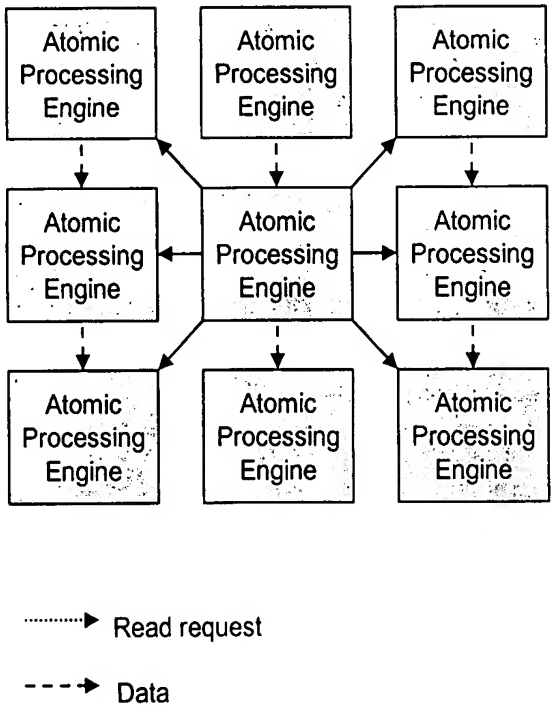


Sequential: Data out of DRAM cell 0

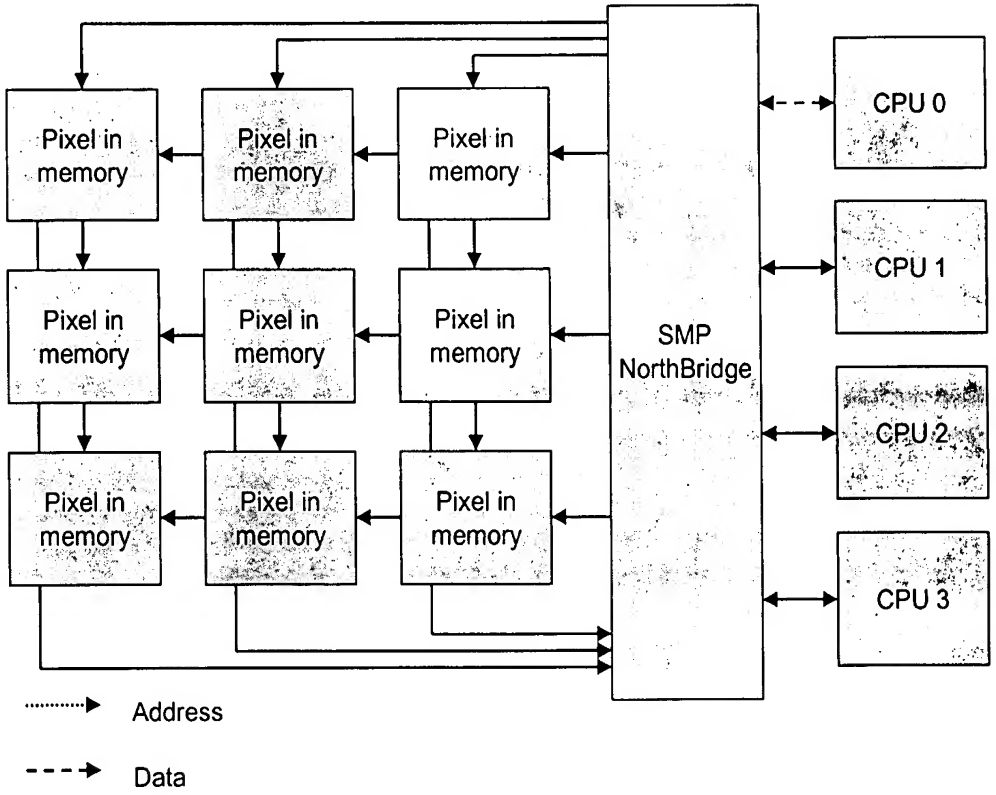


Cycle 1b

Parallel: Data 1

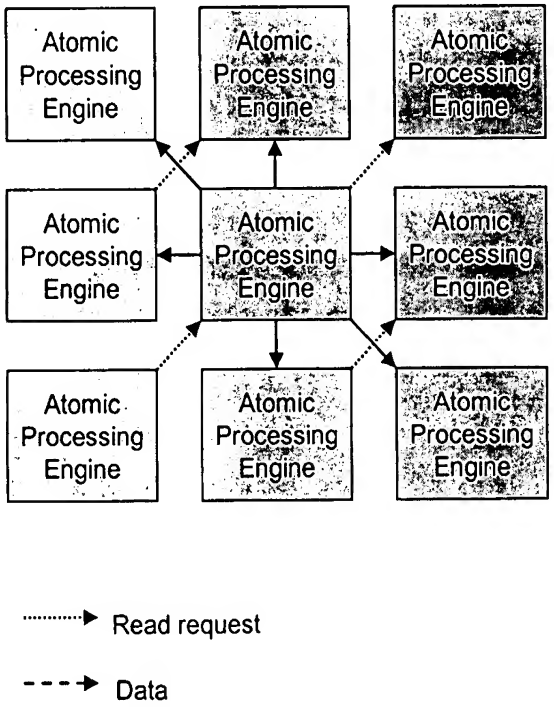


Sequential: Data out of NorthBridge into CPU 0

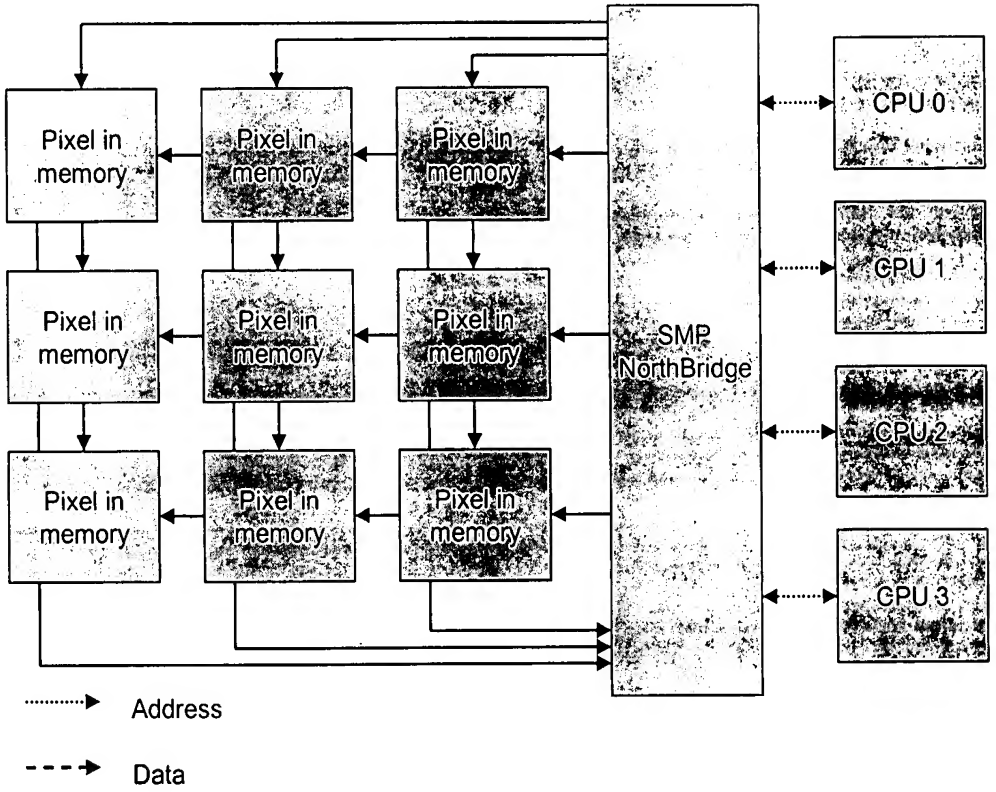


Cycle 2a

Parallel: Read Request 2

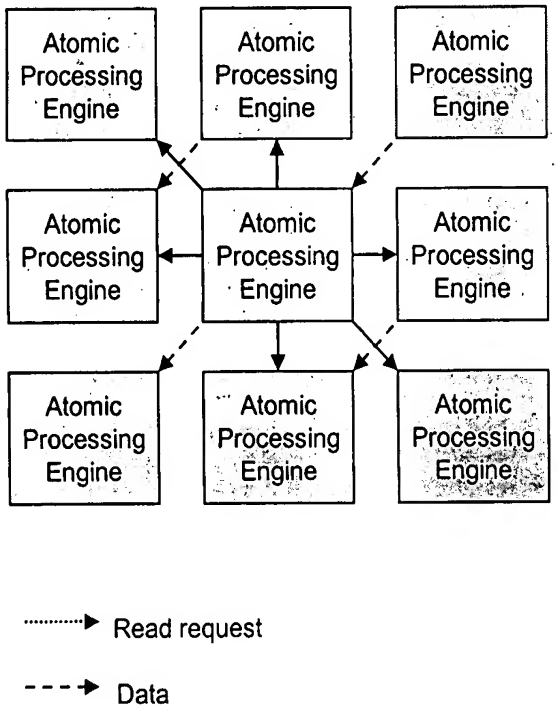


Sequential: Read Request CPUs to NorthBridge

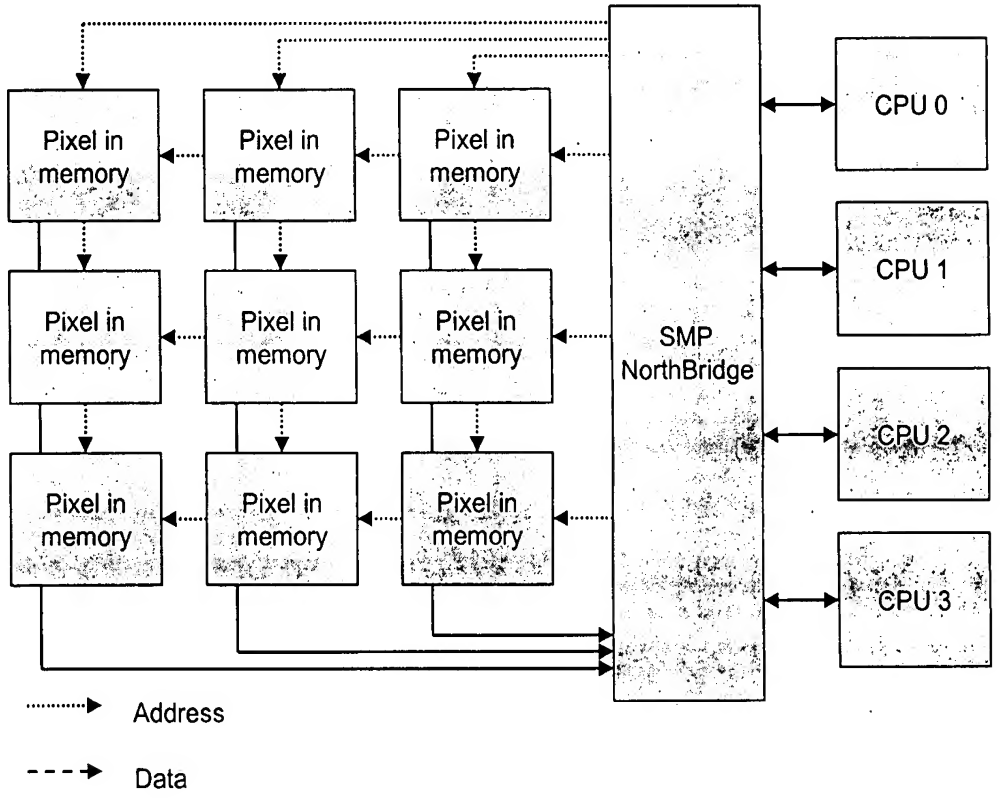


Cycle 2b

Parallel: Data 2

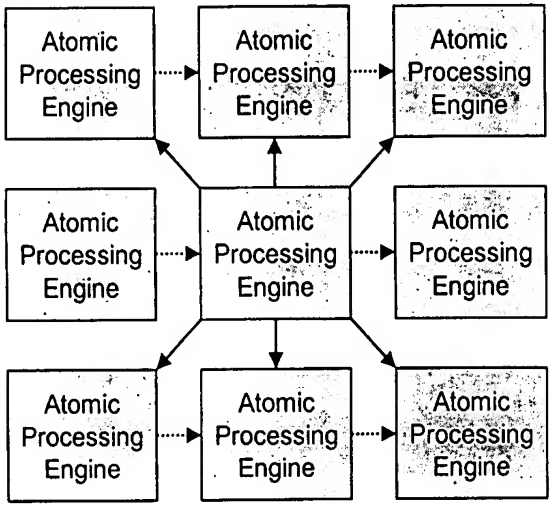


Sequential: RAS and CAS from NorthBridge to DRAM

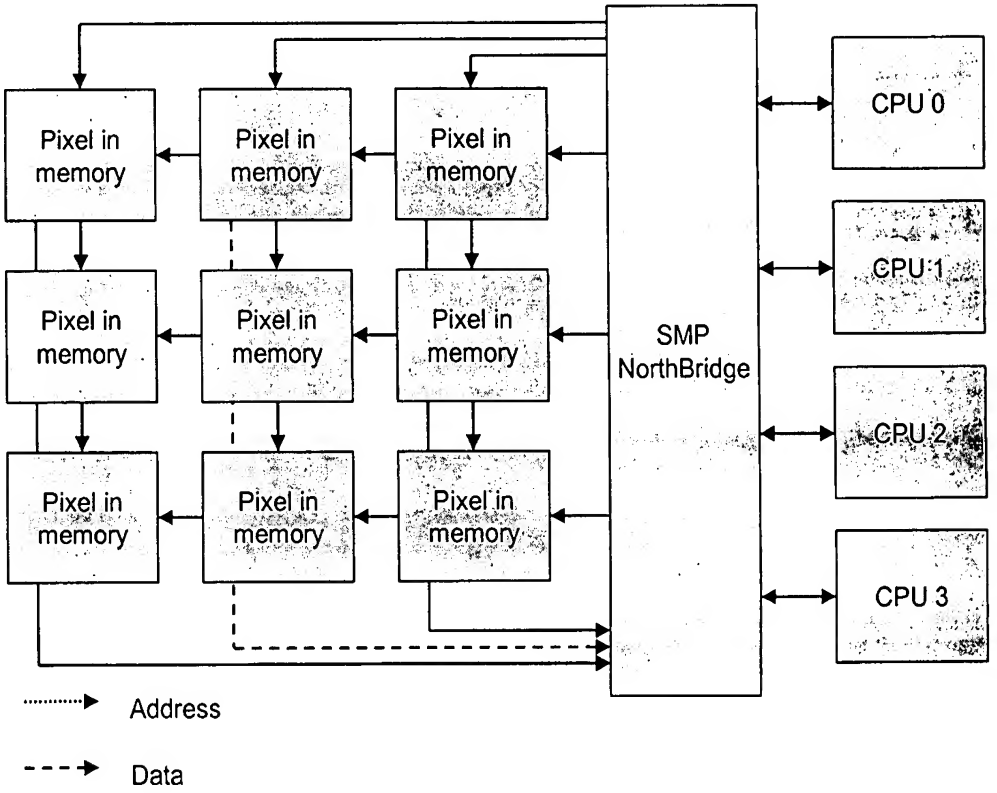


Cycle 3a

Parallel: Read Request 3

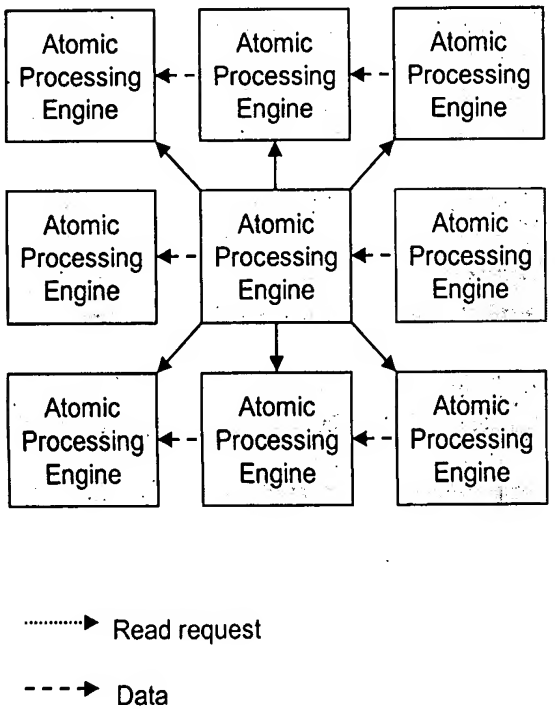


Sequential: Data out of DRAM cell 1

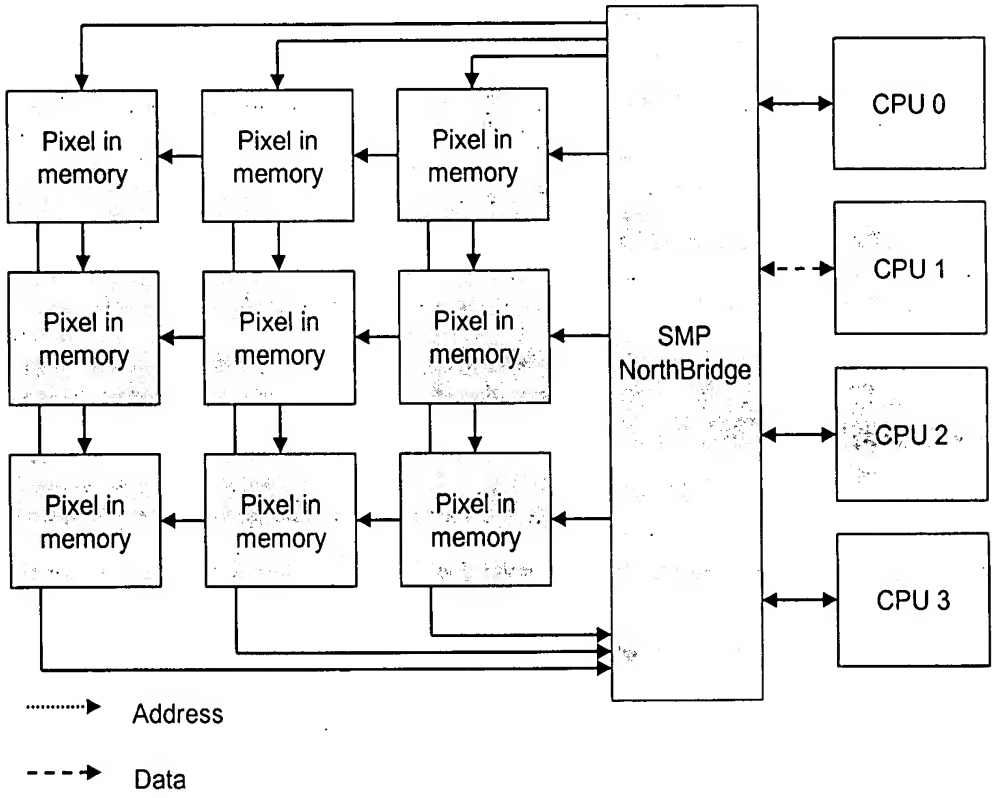


Cycle 3b

Parallel: Data 3

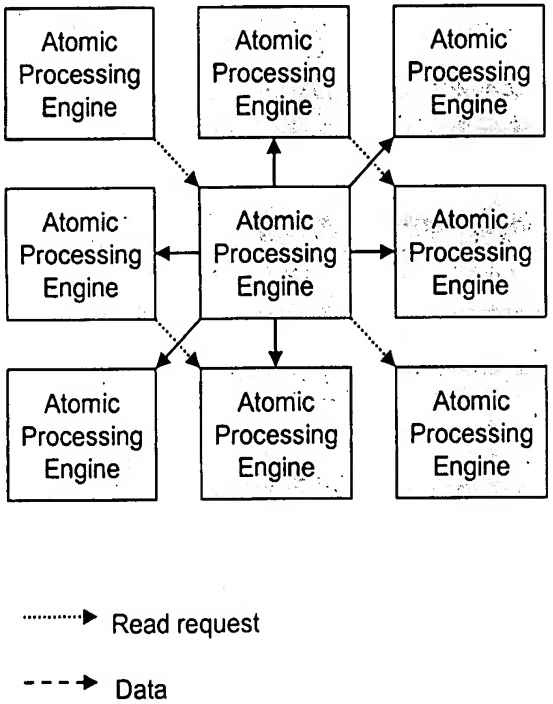


Sequential: Data out of NorthBridge into CPU 1

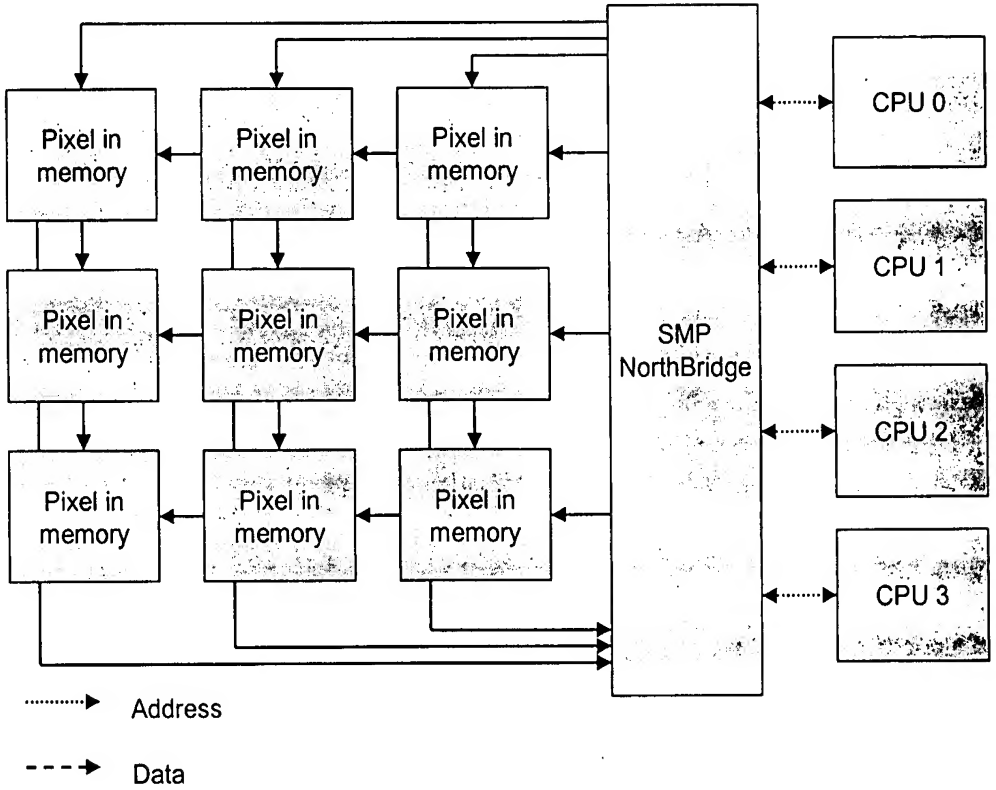


Cycle 4a

Parallel: Read Request 4

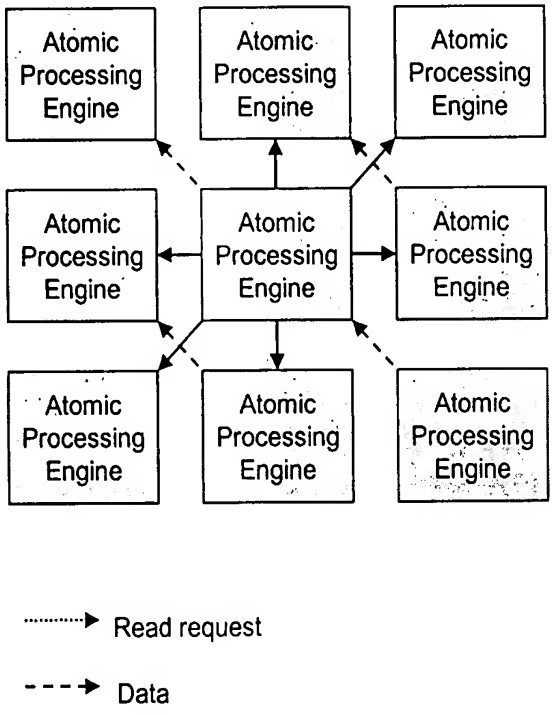


Sequential: Read Request CPUs to NorthBridge

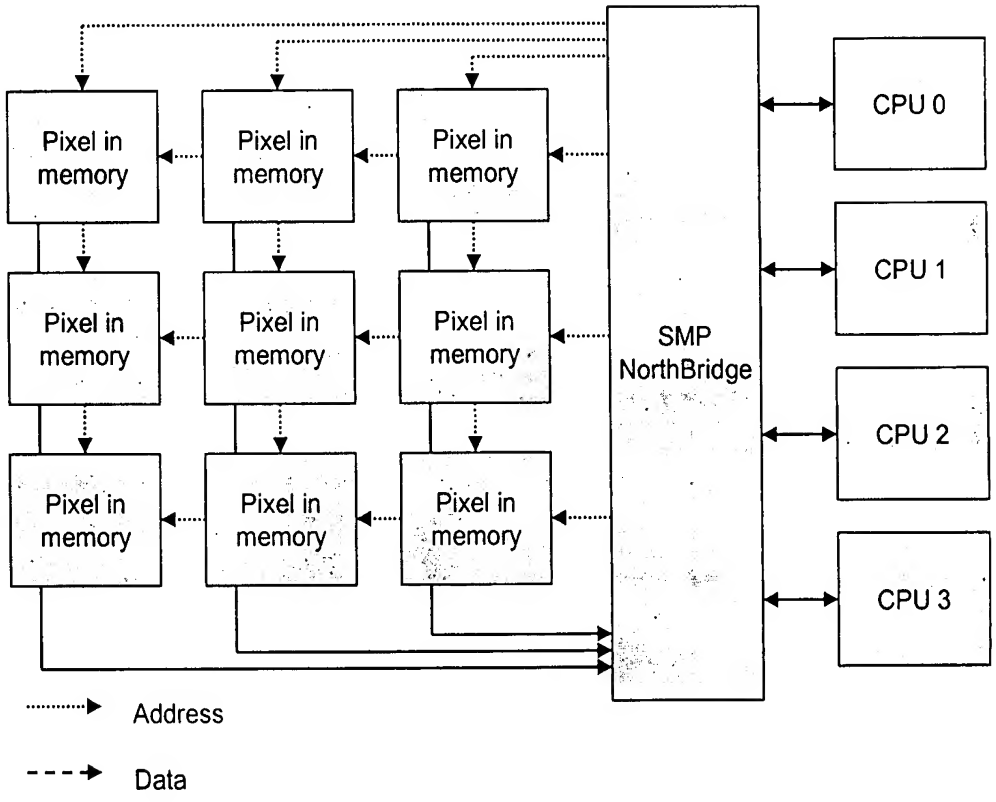


Cycle 4b

Parallel: Data 4

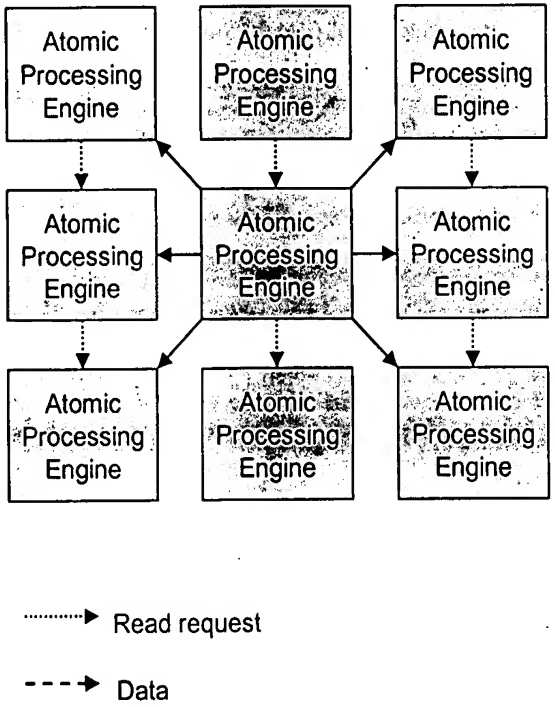


Sequential: RAS and CAS from NorthBridge to DRAM

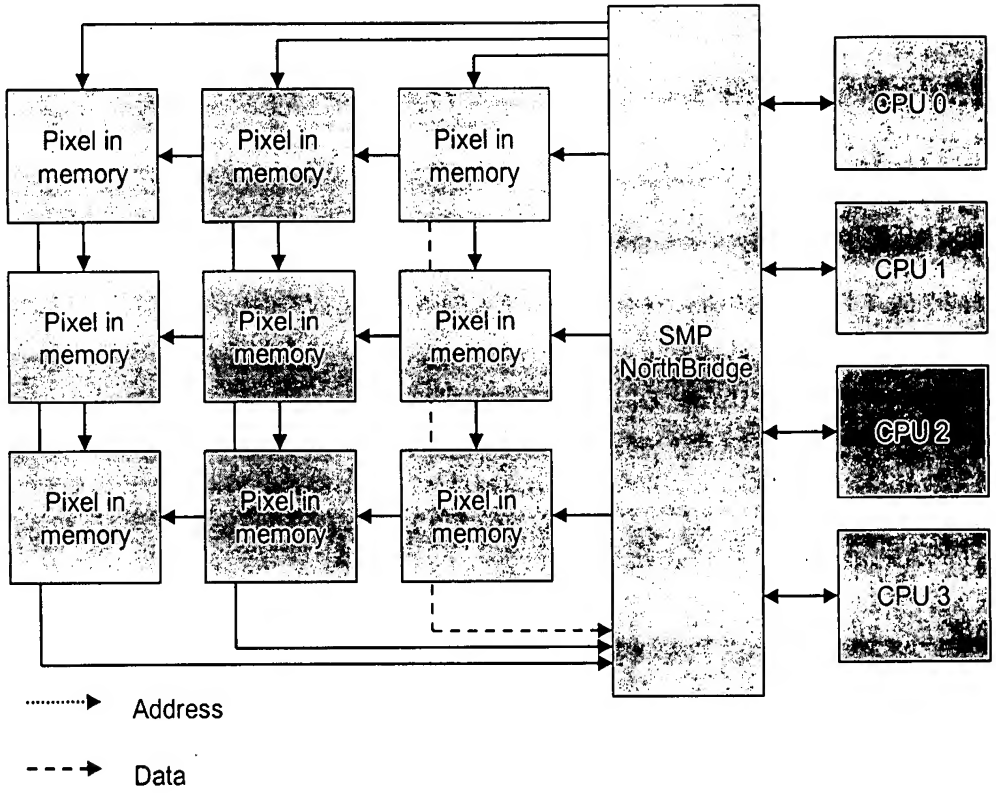


Cycle 5a

Parallel: Read Request 5

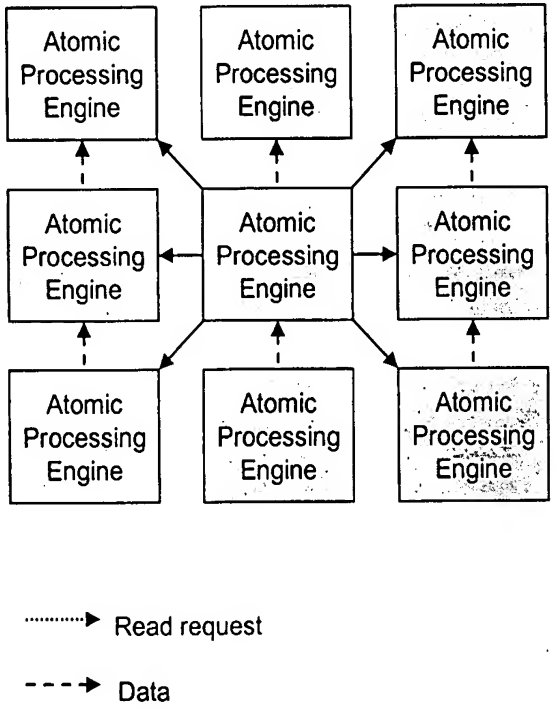


Sequential: Data out of DRAM cell 2

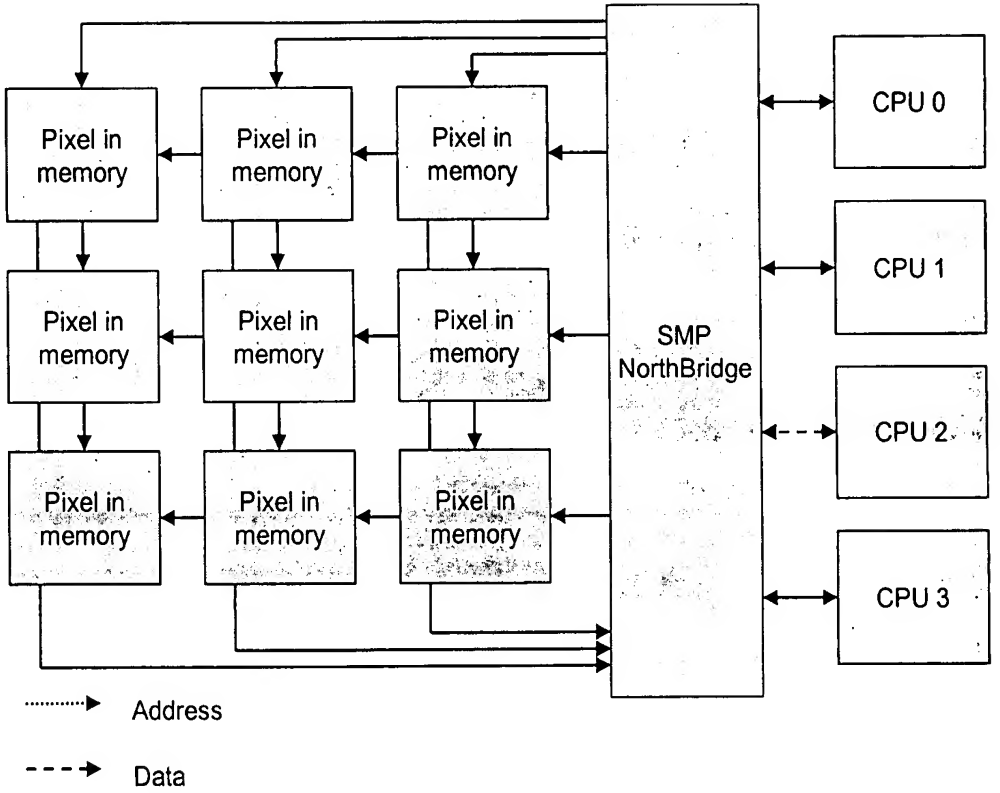


Cycle 5b

Parallel: Data 5

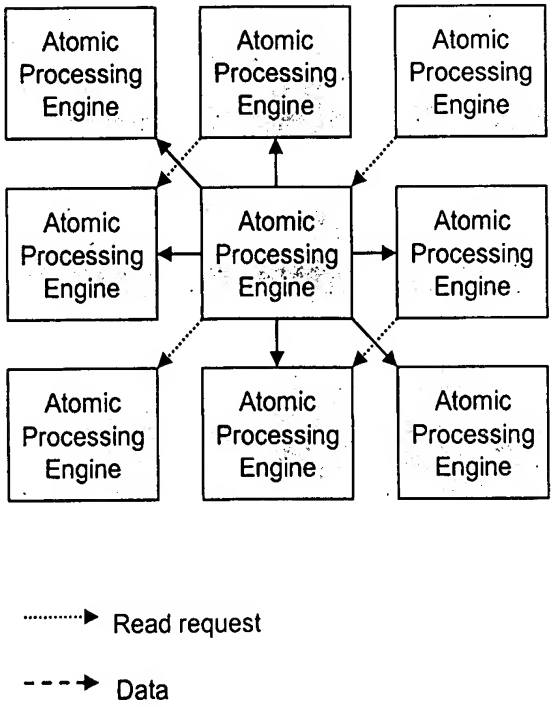


Sequential: Data out of NorthBridge into CPU 2

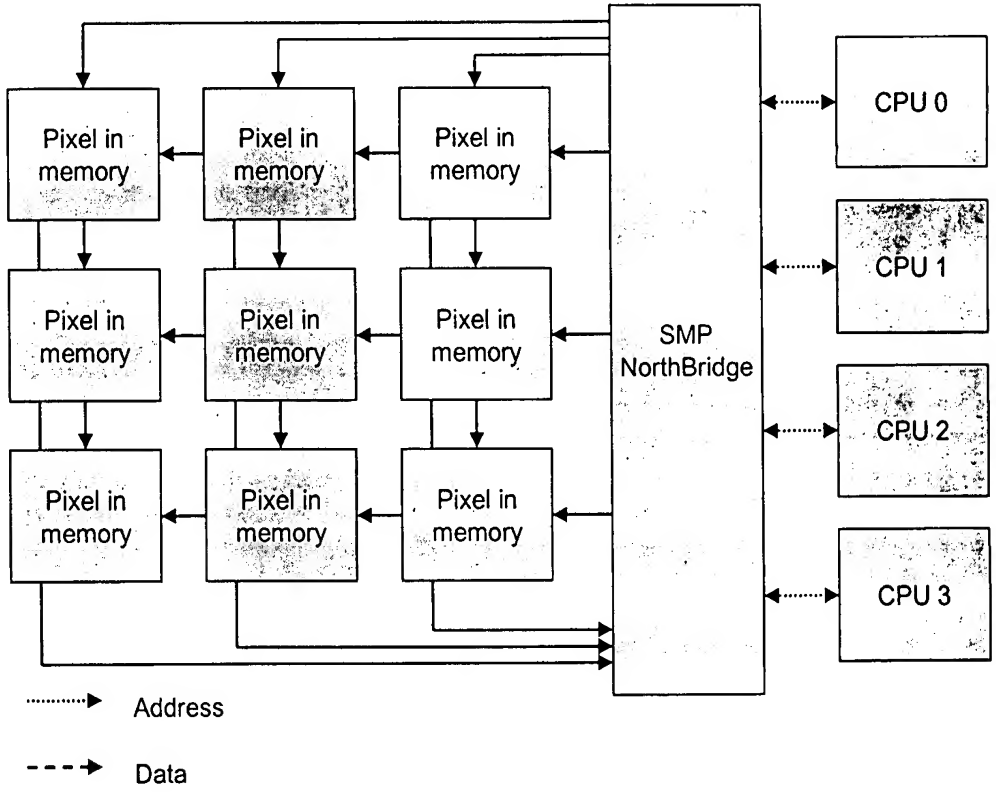


Cycle 6a

Parallel: Read Request 6

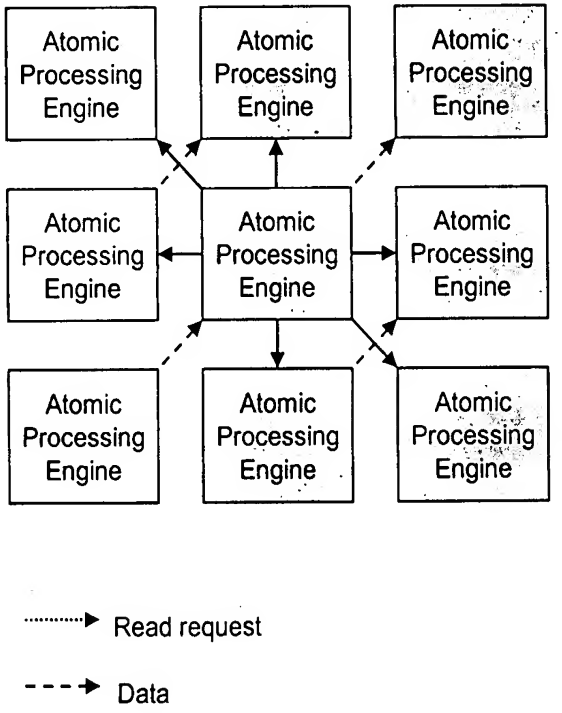


Sequential: Read Request CPUs to NorthBridge

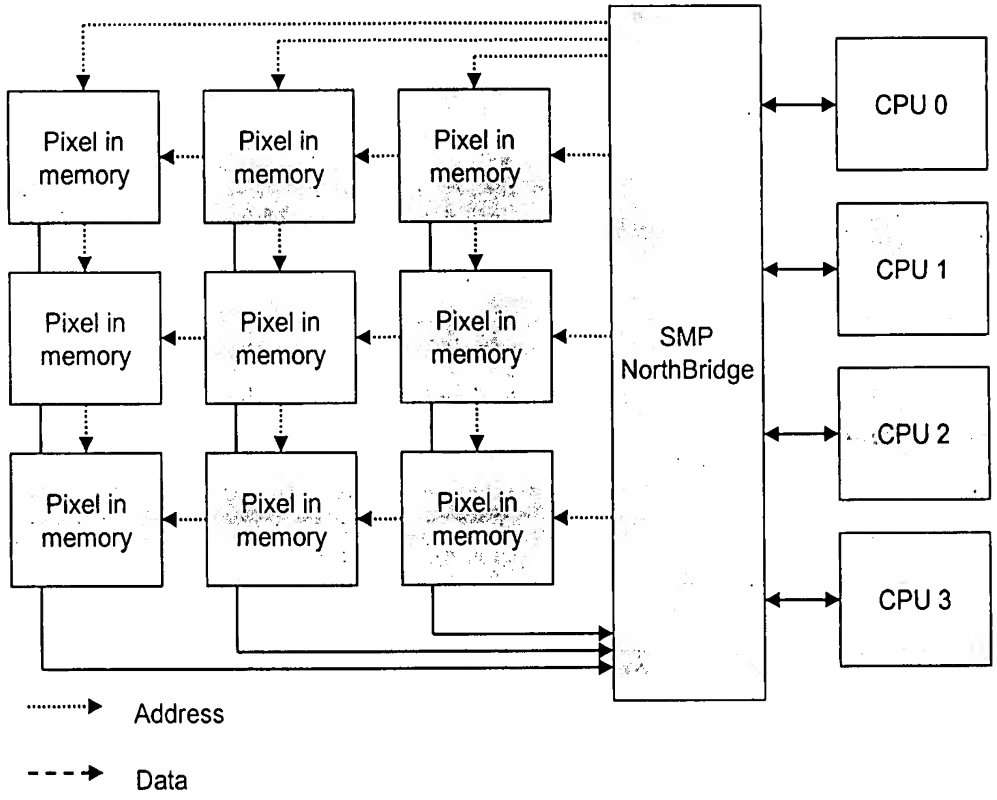


Cycle 6b

Parallel: Data 6

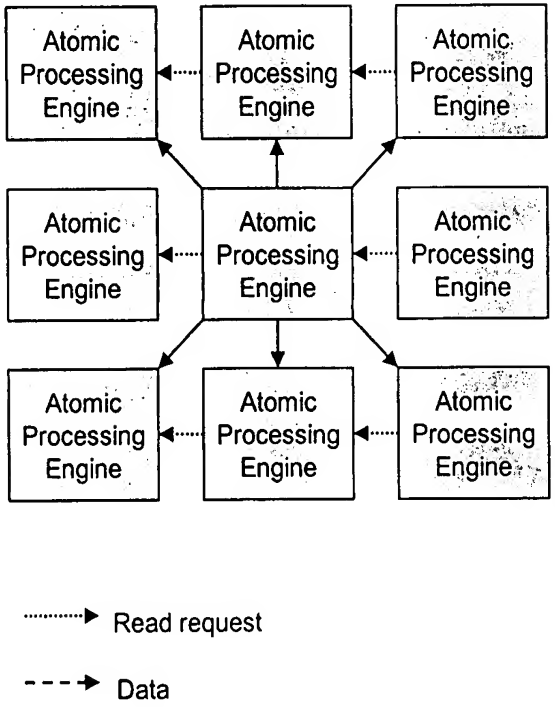


Sequential: RAS and CAS from NorthBridge to DRAM

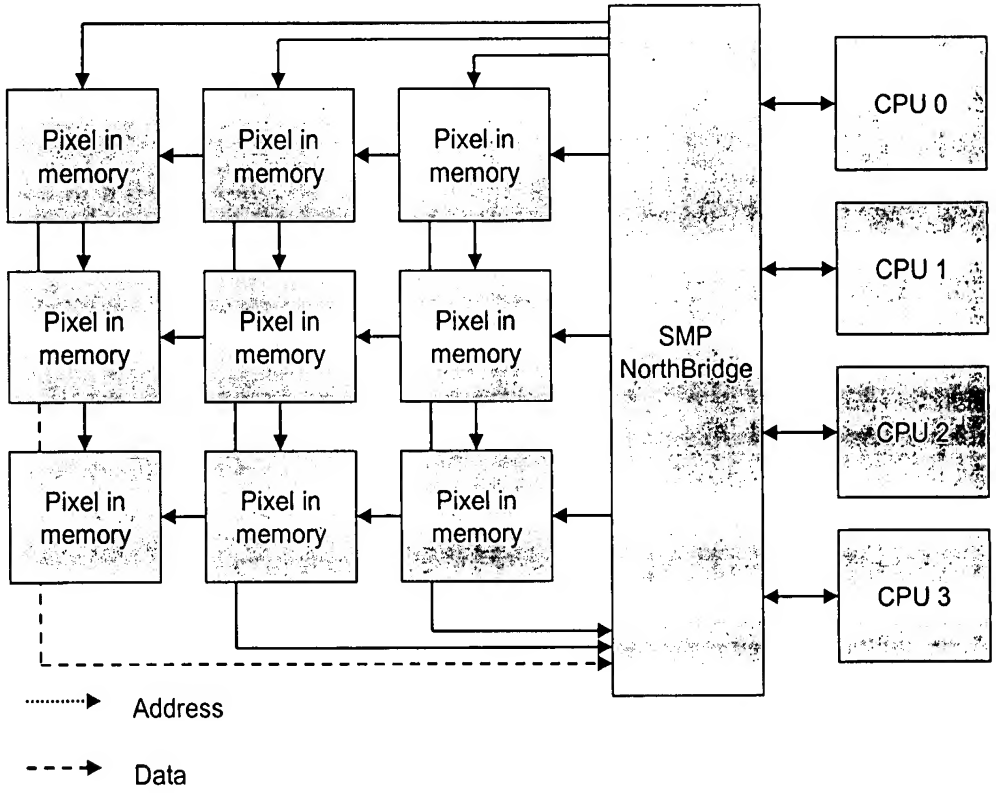


Cycle 7a

Parallel: Read Request 7

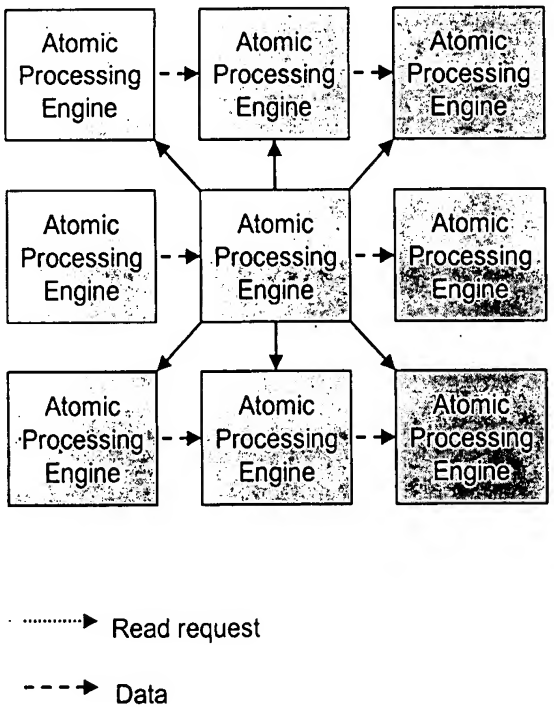


Sequential: Data out of DRAM cell 3

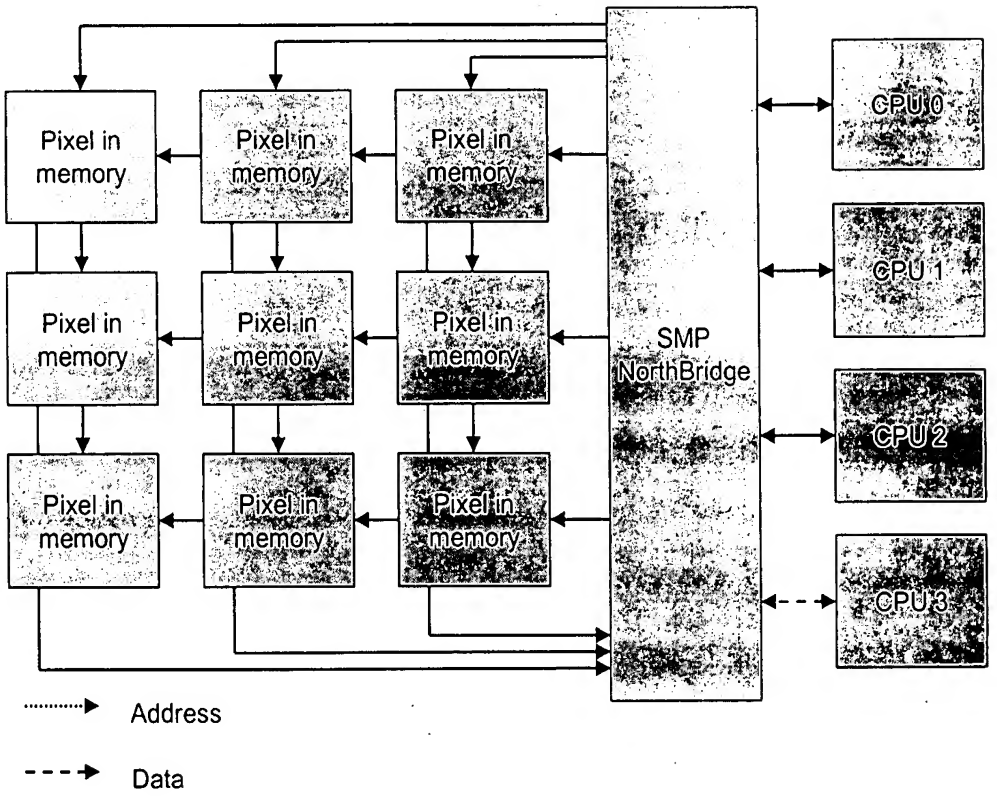


Cycle 7b

Parallel: Data 7

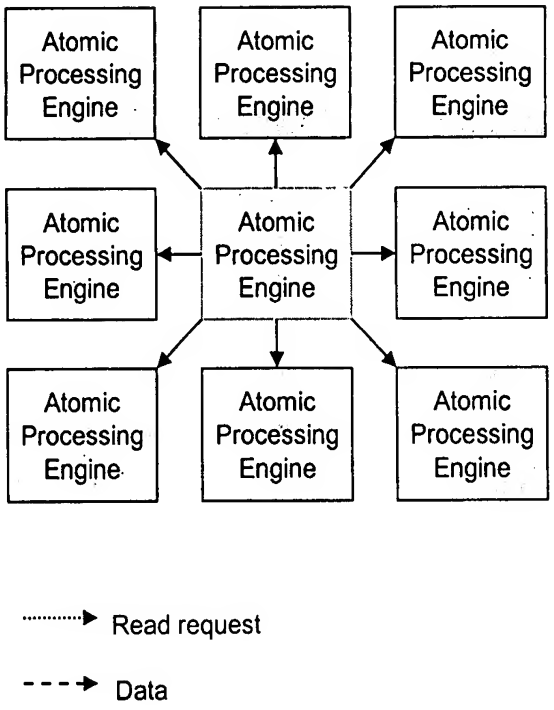


Sequential: Data out of NorthBridge into CPU 3

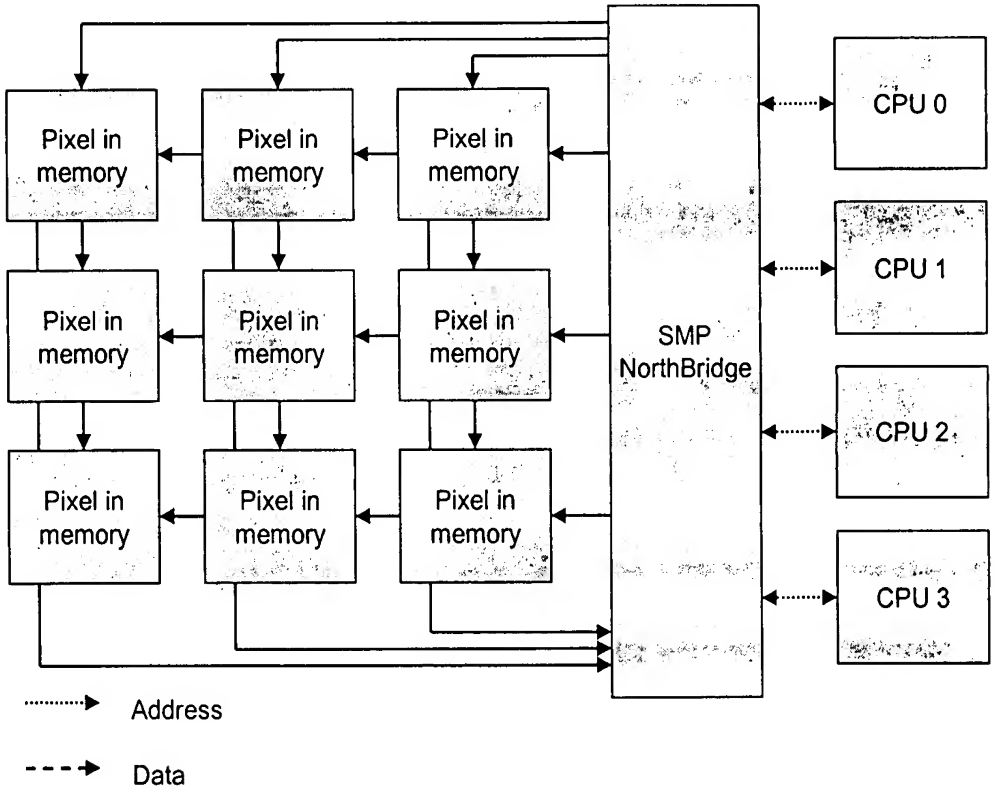


Cycle 8a

Parallel: Read Request 8 (int.)

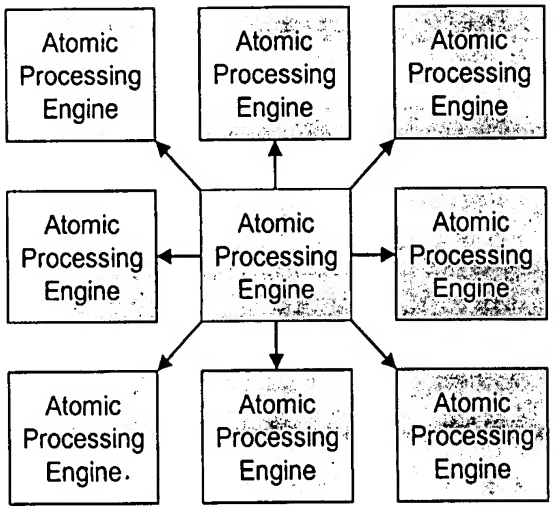


Sequential: Read Request CPUs to NorthBridge

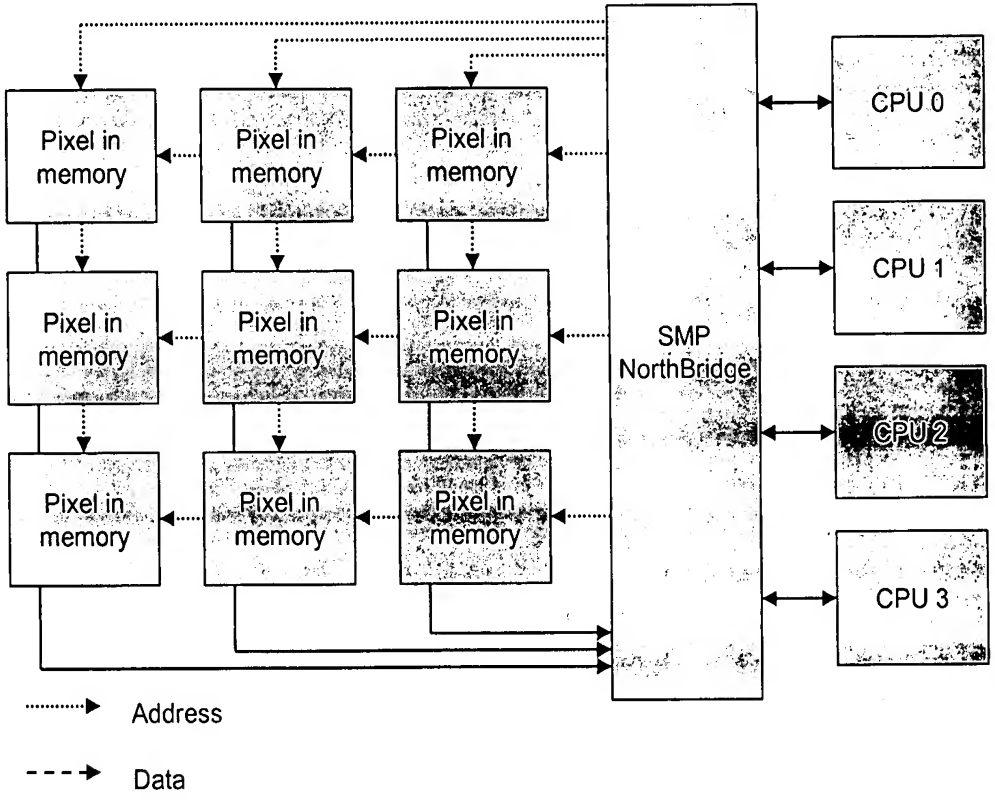


Cycle 8b

Parallel: Data 8 (int.)

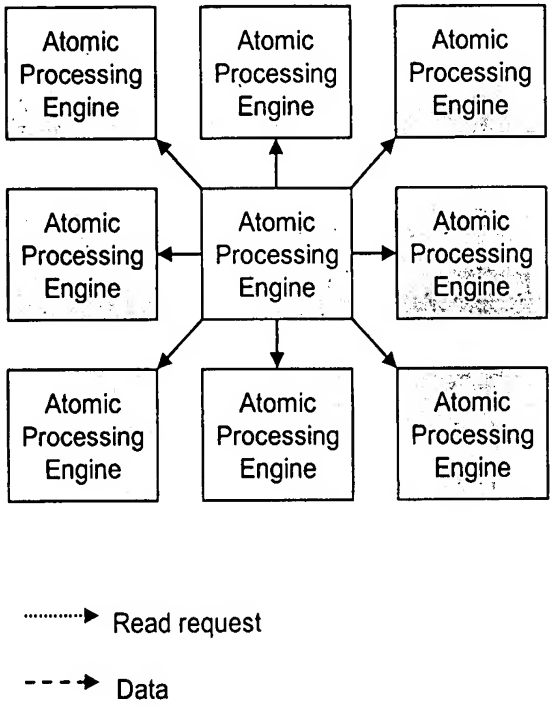


Sequential: RAS and CAS from NorthBridge to DRAM

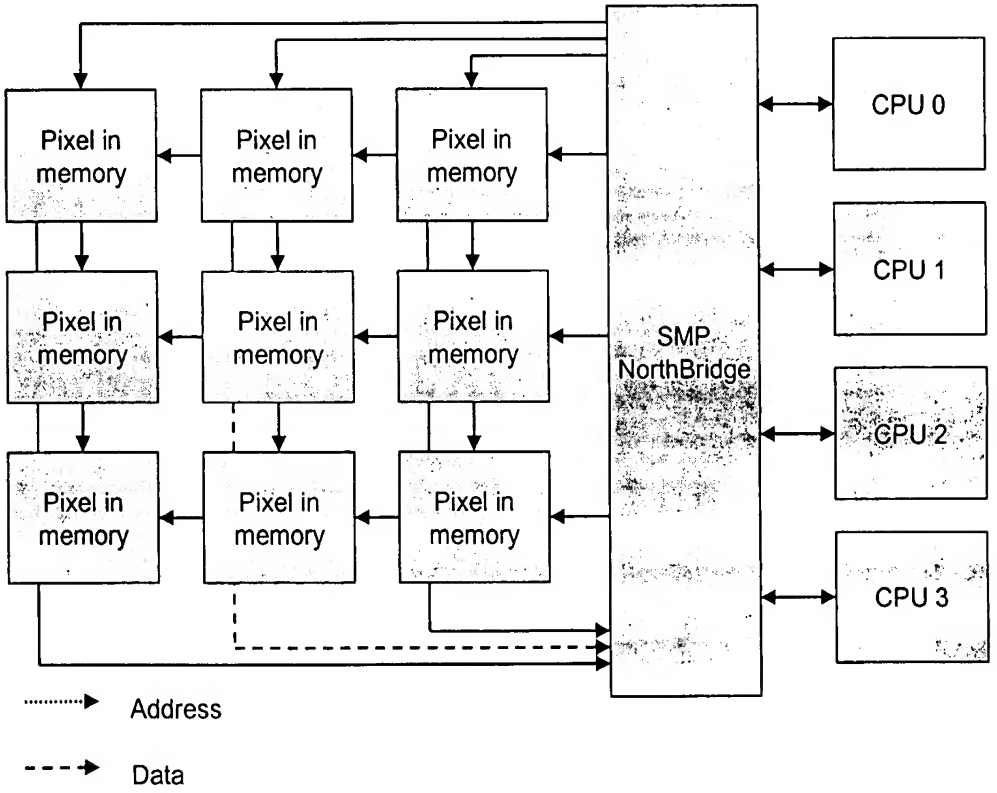


Cycle 9a

Parallel: Processing

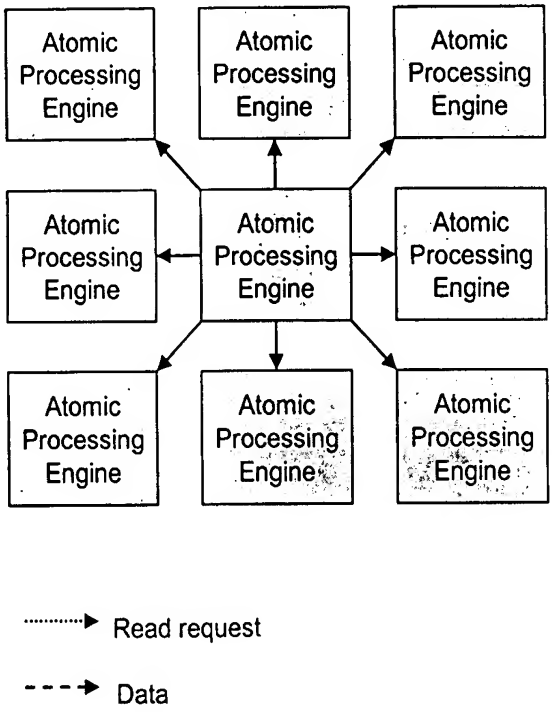


Sequential: Data out of DRAM cell 4

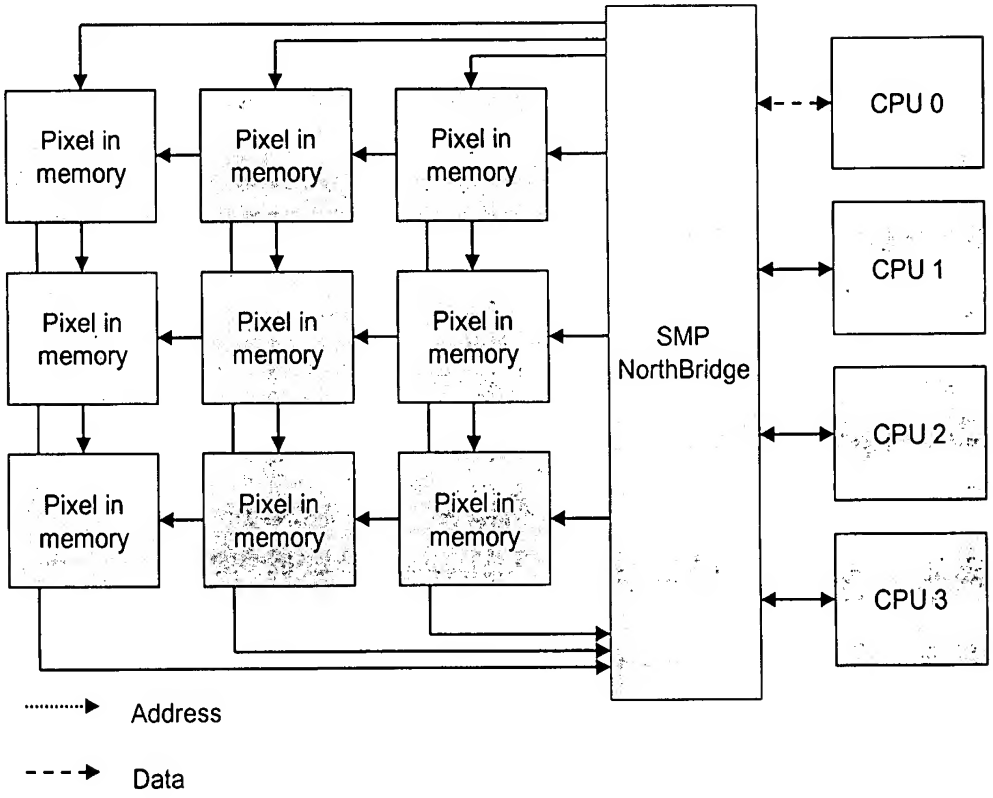


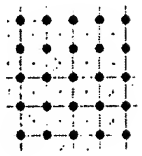
Cycle 9b

Parallel: Processing



Sequential: Data out of NorthBridge into CPU 0





Conclusion

- At this point the center processor of the MPP SIMD cluster has polled all of its 8 neighbors and processed their data and its own. The new cell content is in the center processor. Since all processors are center processors of their own cluster, the MPP SIMD is done.
- The sequential architecture has finished polling 5 out of all - in this case 9 - cells, and the processing power not not used efficiently since mostly contention forced the processors to run idle.
- On a quad VGA resolution with 16 IPEs, our parallel architecture would have finished the task, whereas a sequential processing architecture had completed 5 pixels out of 1280 * 960 = 1228800.
- Uniprocessor CPU or DSP based architectures are memory bound in image processing applications, SMP systems are even more memory bound. They are not compute bound.